MMU2-16LE *SmartMonitor* ®

Malfunction Management Unit

- Training Seminar -

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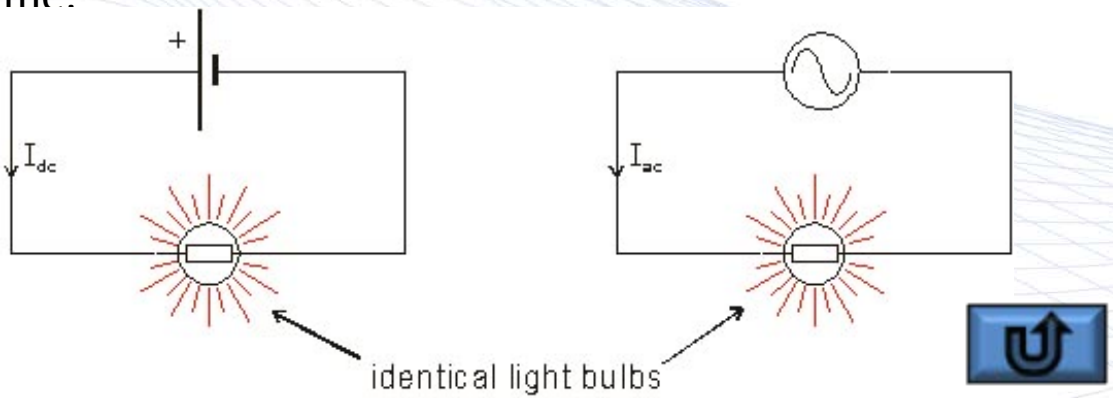
MMU2-16LE Vrms

Why do we use Vrms?

Vrms

- What is Vrms
- Attempts to find an average value of AC would *directly* provide you the answer **zero**... Therefore, RMS values are used. They help to find the effective value of AC (voltage or current).
- **RMS** is a mathematical quantity (used in many *math* fields) used to compare both alternating and direct currents (or voltage). In other words, the RMS value of AC (current) is the direct current (DC) equivelant which when passed through a resistor for a given period of time *would* produce the same heat, or light, as that produced by the DC current when passed through the same resistor for the same time.



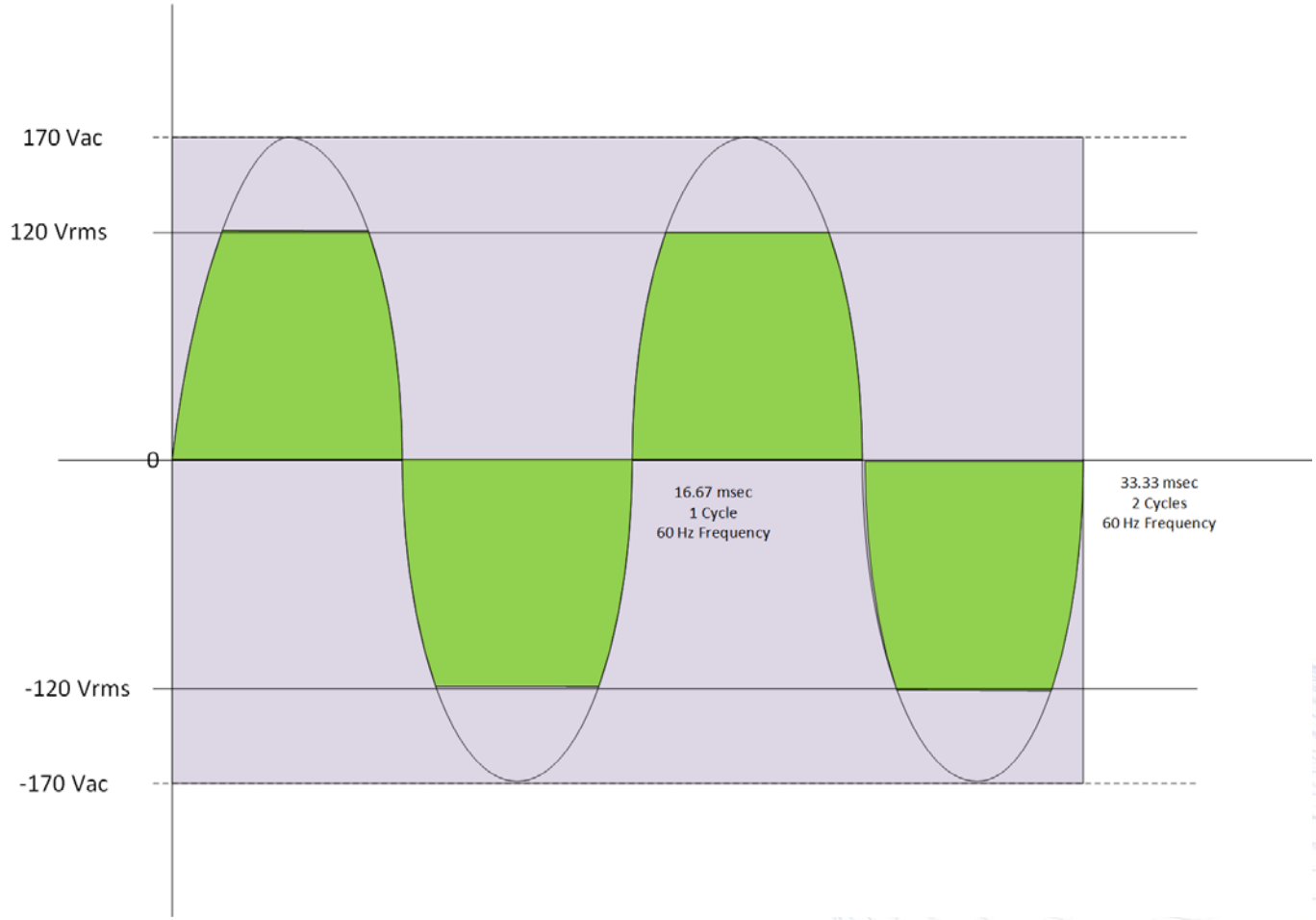
Examples

- Two light bulbs – one powered by AC the other by DC
  - Consider that both the bulbs, (resistors) are giving out equal-level of brightness. So, they're losing the same amount of heat (regardless if AC or DC). In order to relate both as equivalent, we have nothing to use better than the RMS value. The direct voltage equivalent for 120 Vdc for the bulb is 120 Vrms while the alternating voltage is 170 Vac. Both give the same power output.
  - $Vrms = Vdc = \frac{Vac}{\sqrt{2}} = 120\ V$
  - $Or\ \ Vrms = 170\ Vac \cdot \sqrt{2}$

Examples

- We use the RMS value for all kinds of AC appliances. We're taking the RMS because AC is a varying quantity (consecutive positives and negatives). Therefore, we require a mean value of their squares thereby taking the square root of sum of their squares.
- For the MMU this allows us to have a standard voltage reference to determine brightness of indications and voltage levels that could be too low for proper brightness.
- For testing and certification it gives us a standardized reference and calculation to determine if the monitor is calibrated correctly for voltage monitoring.

Examples



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MMU2-16LE *SmartMonitor* ®

Malfunction Management Unit

Basic Training and Setup

Introduction

- Goal: Better Understand Monitor & Cabinet System Operation.
- Topics
  - General Signal Monitor Concepts
  - TS2 MMU Features
  - EDI MMU2-16LE *SmartMonitor* Installation
  - TS2 Trouble Shooting

Motivation

- Signal Monitors help ensure proper intersection operation.
- Signal Monitors help trouble shoot malfunctioning equipment.
- Liability risks have increased dramatically.
- Costs of trouble shooting & repairing malfunctions has increased.

MMU2-16LE *SmartMonitor* Overview

- Exceeds all requirements of NEMA TS2-2003 including additional monitoring functions beyond TS2
- Real time communications with the CU
- EDI MMU2-16LE enhanced functions
  - Full Intersection Display & Menu Interface
  - True Rms Voltages
  - Full Event Logging
  - Built-in Set-up and Diagnostic Wizards
  - Optional Ethernet Port
  - NEMA Standard Flashing Yellow Arrow
  - Type 12 with SDLC Mode for legacy TS-1 Cabinets

MMU2-16LE and MMU-16LE

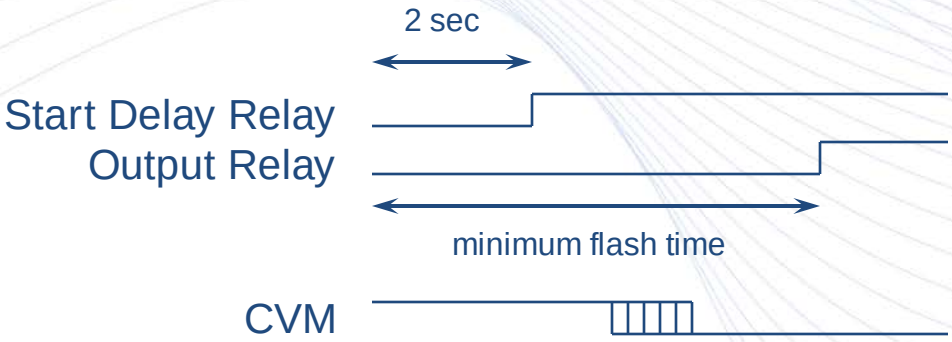
- What is the difference between the MMU-16LE(ip) and the new MMU2-16LE(ip)?
  - The units are functionally the same except for the Flashing Yellow Arrow (FYA) operation.
  - Only the MMU2-16LE(ip) complies with the new NEMA TS-2 Amendment #4-2012 Flashing Yellow Arrow standard.
  - The MMU-16LE(ip) will be continue to be provided for backward interchangeability with existing MMU-16LE(ip) installations where legacy FYA or FYAC operation is used.
- The MMU2-16LE(ip) is recommended for all new procurements.

Dual Mode Operation

- TS2 16 Channel Mode (Type 16)
  - Red / Don't Walk, Yellow, Green / Walk
- TS1 12 Channel Mode (Type 12)
  - Red, Yellow, Green, Walk
- The *Type Select* input programs the mode.

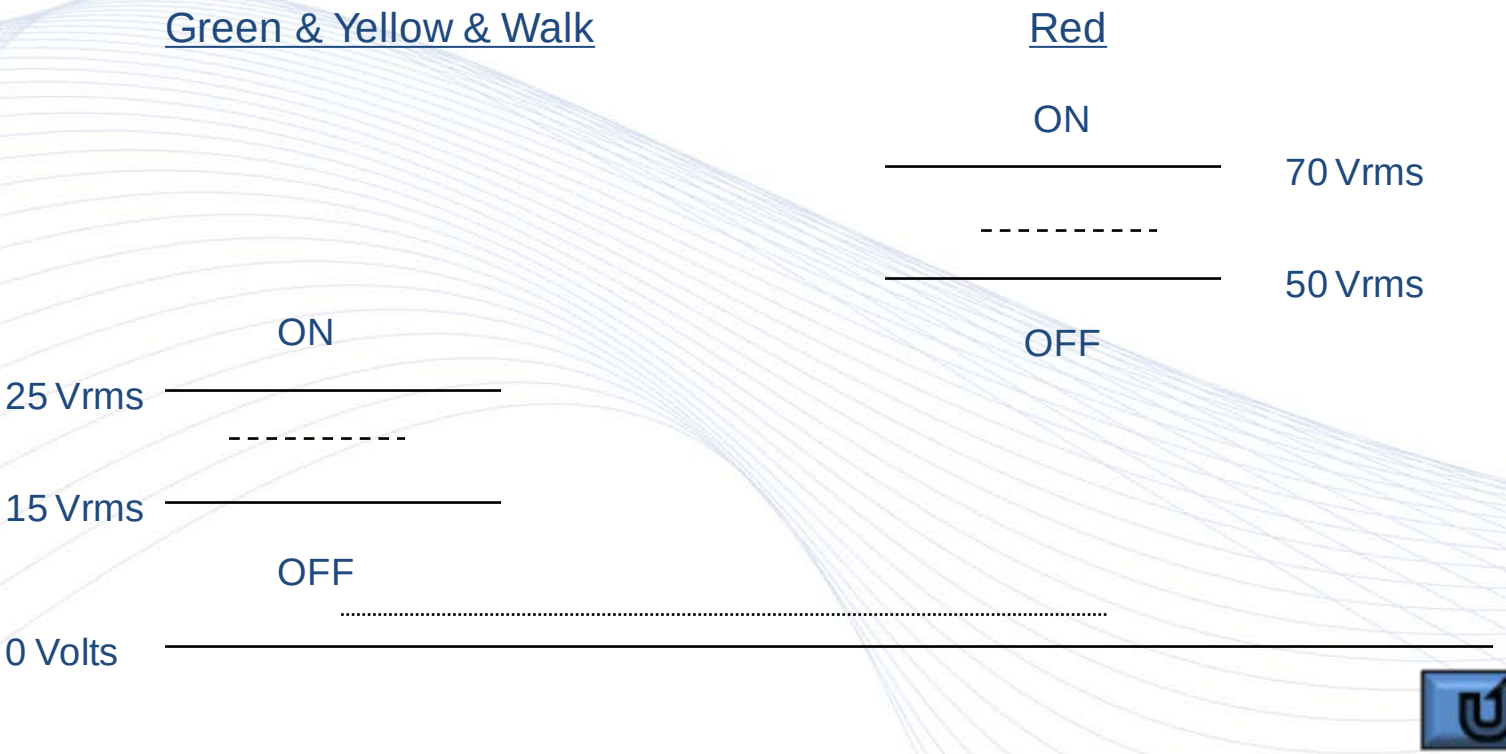
Power-up & Flash Operation

- The monitor *Output* Relay controls the mercury contactor and flash transfer relays.
- The monitor *Start Delay* Relay controls AC power to the CU.



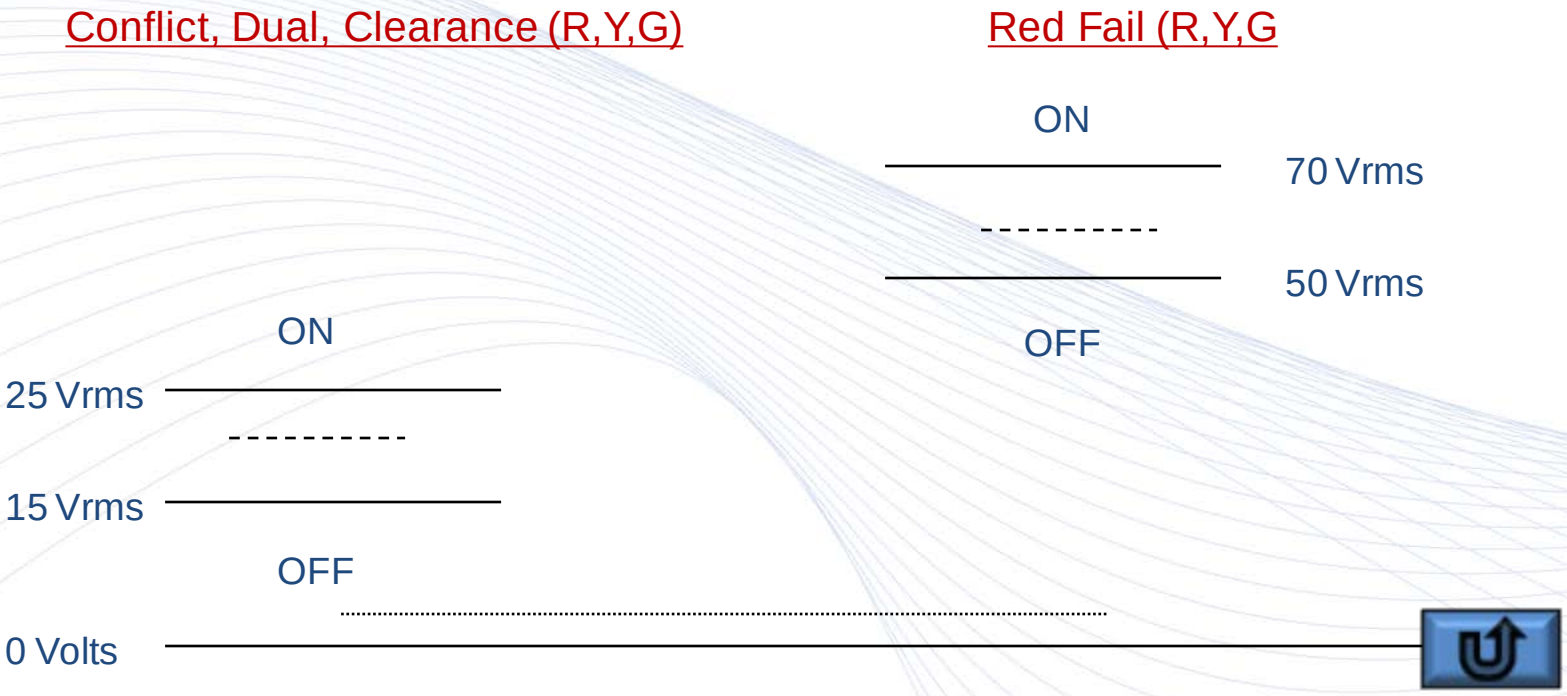
Field Input Thresholds

- The MMU2-16LE is a voltage sensing device



LEDguard® Field Input Thresholds

- No more ambiguity in the 20-60 volt range



MMU2-16LE *SmartMonitor* Faults

- Conflict
  - Detects two or more active *proceed* channels which are programmed to be incompatible.
  - Program Card jumpers provide permissive programming input to monitor.
  - Timing: 200 ms to 450 ms, 350 ms typical.
  - Causes
    - Load switch output is shorted “ON”
    - Short Circuit in the field
    - Loss of load in the field
    - Improper programming of CU or Program Card

MMU2-16LE *SmartMonitor* Faults

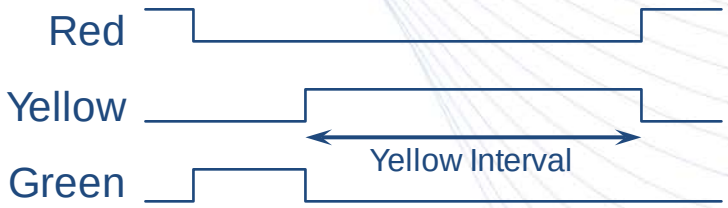
- Red Fail
  - Detects a channel which has no active inputs
  - No R or Y or G
  - Timing: 700 ms to 1000 ms, 800 ms typical.
  - Controlled by Red Enable input & per channel enables.
  - A loss of Red signal load does not produce a Red Fail
  - Causes
    - CU
    - Loadswitch

MMU2-16LE *SmartMonitor* Faults

- Dual Indication Fault
  - Detects more than one active input (color) on a channel.
  - Can *anticipate* Conflict malfunctions before they are displayed on the signals.
  - Controlled by Red Enable input and per channel RG, RY, & GY enables.
  - Dual Indication is the only way to detect the Red no-load condition.
  - Causes
    - LS, Short Circuit, Loss of Load

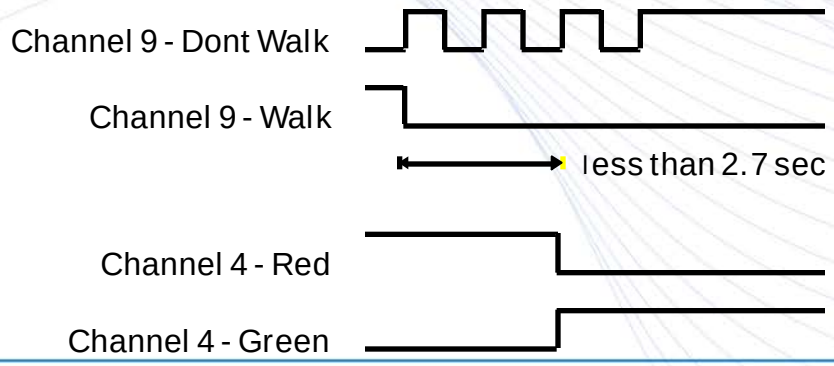
MMU2-16LE *SmartMonitor* Faults

- *Minimum Yellow* Clearance Fail
- Measures the Yellow Change interval for an MUTCD 3 second minimum.
  - Timing: 2.6 to 2.8 seconds
  - Enabled by Red Enable input and MYCD jumpers.
  - Causes
    - CU malfunction, preemption, programming error



MMU2-16LE *SmartMonitor* Faults

- *Minimum Yellow + Red* Clearance Fail
  - Measures the interval from a terminating Green to the next active conflicting Green.
  - Timing: 2.6 to 2.8 seconds
  - Provides clearance protection for Pedestrian channels or channels with no Yellow.
  - Controlled by Red Enable input and per channel MYRCD enables.



MMU2-16LE *SmartMonitor* Faults

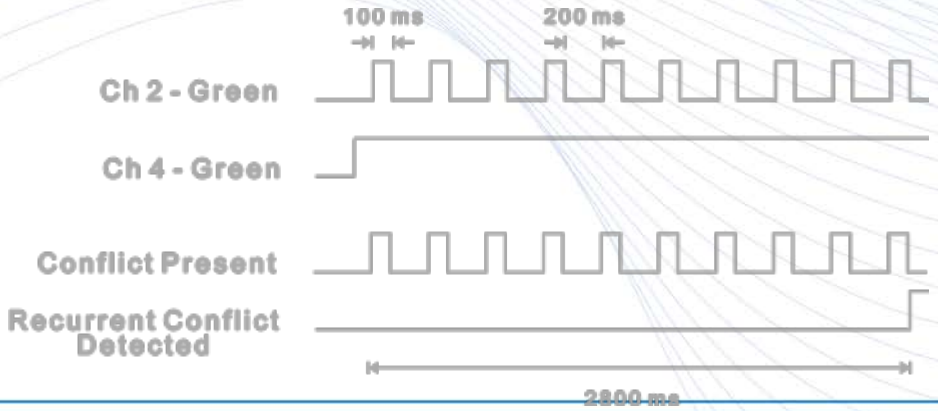
- Controller Voltage Monitor (CVM)
  - The CU will use this logic signal output to indicate a CU problem or to force the monitor to the flash state.
  - Timing: 150 ms typical, non-latching.
- 24 Volt Monitor (24V-1 & 24V-2)
  - Monitors two 24 Vdc power supplies.
  - Voltage: <18 Vdc = fault, >22 Vdc = operate
  - Timing: 150 ms typical, non-latching.

MMU2-16LE *SmartMonitor* Faults

- Port 1 Fail
  - Detects that no Type 0 message has been received on the SDLC port from the CU.
  - Timing: 300 ms, latching after 3rd occurrence in a 24 hour period
- Diagnostic Fail
  - Internal MPU watchdog circuit
  - ROM, RAM, or EEPROM failure
  - Internal power supply failure

MMU2-16LE *SmartMonitor* Faults

- Recurrent Pulse Detection
  - Detects intermittent or pulsing signal conditions which may not meet the requirements of typical continuous fault detection algorithms.
  - The RECURRENT PULSE STATUS will display with the Conflict or Red Fail or Dual Indication fault.



AC Line Power Failure

- TS2 Power Failure is defined for all devices as AC+ voltage less than 89 Vac.
  - The MMU2-16LE dropout voltage is 92 Vrms.
  - The MMU2-16LE restore voltage is 96 Vrms.
- MMU2-16LE will respond if failure is greater than 500 ms.
  - Start Delay and Min Flash sequence
- MMU2-16LE will not respond if failure is less than 450 ms.

NEMA TS2 Standard

- Higher level of functionality and better specification detail
- Standardized high-speed communication bus
- Less cabinet wiring
- More powerful diagnostic tools to prevent and diagnose problems
- Safer - Redundant monitoring, MMU compatibility check, etc in CU

SDLC Communications (Port1)

- Data interchange between the MMU and CU every 100 ms:
  - MMU2-16LE Compatibility Programming
  - MMU2-16LE Field Status
  - MMU2-16LE Fault Status
  - CU Load Switch Command Status
  - Time and Date

EDI Field Check Monitoring

- The MMU2-16LE *SmartMonitor* continuously compares the CU output data to the field status.
- This diagnostic data can isolate whether the fault was due to a CU malfunction OR a failure in the load bay or field.
- The channel(s) which malfunctioned are also directly identified.

The Diagnostic Wizard

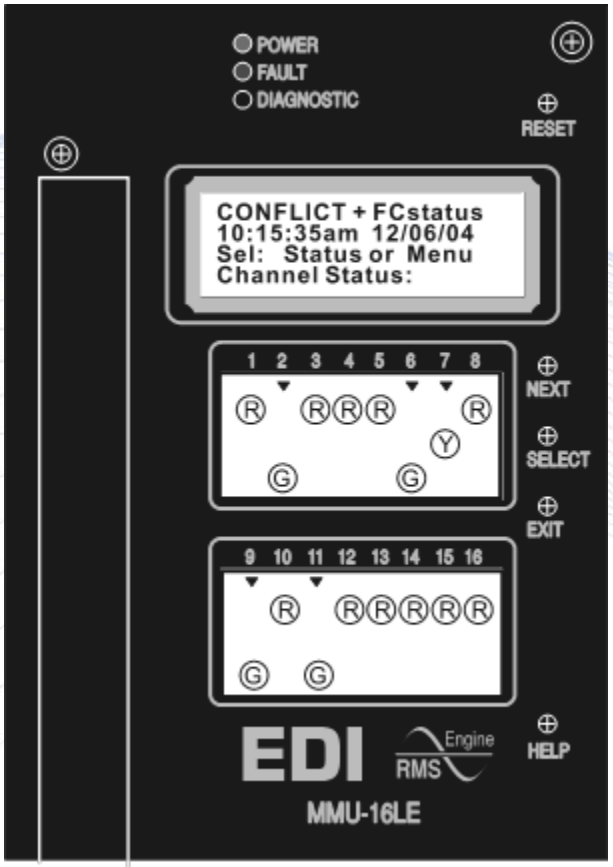
In TS-2 Type 16 mode, the Diagnostic Wizard *automatically pinpoints faulty signals* and offers relevant trouble shooting advice.

- First screen shows an explanation of the fault type and a concise view of only the channels involved in the fault.
- Second screen pinpoints *known* faulty signals.
- The last step offers the technician a list of probable causes to trouble shoot.

Just press the "Help" button!

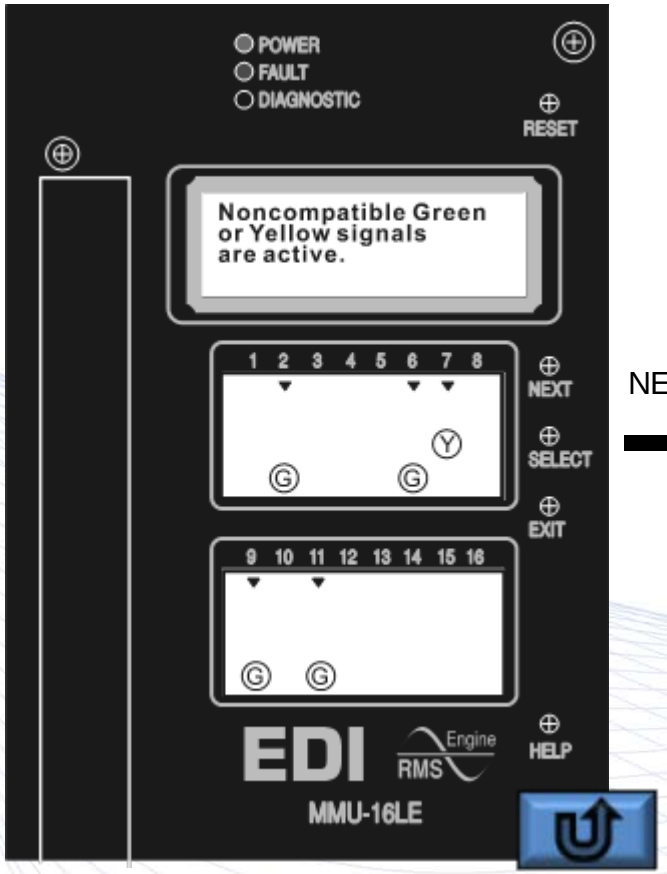
The Diagnostic Wizard

Main Status Screen



HELP

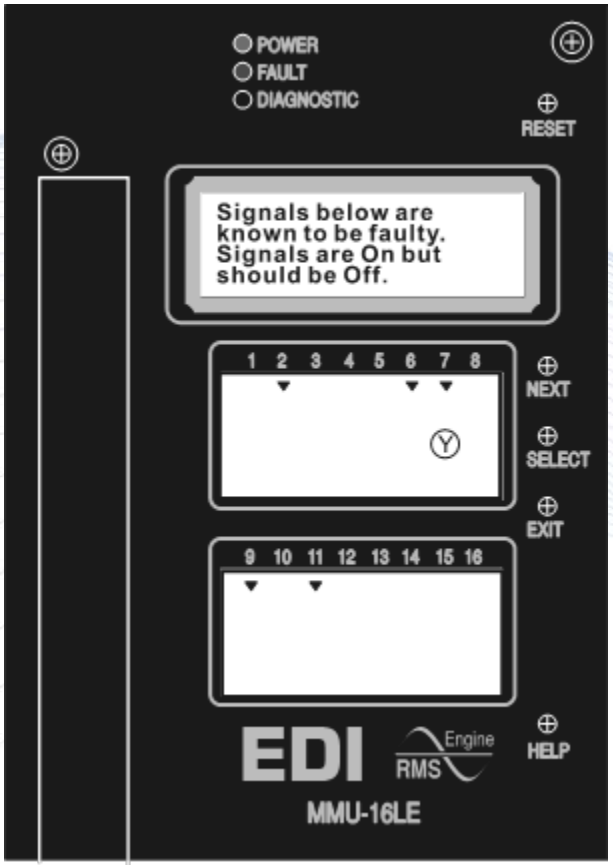
First Wizard Screen
(Concise Display)



NEXT

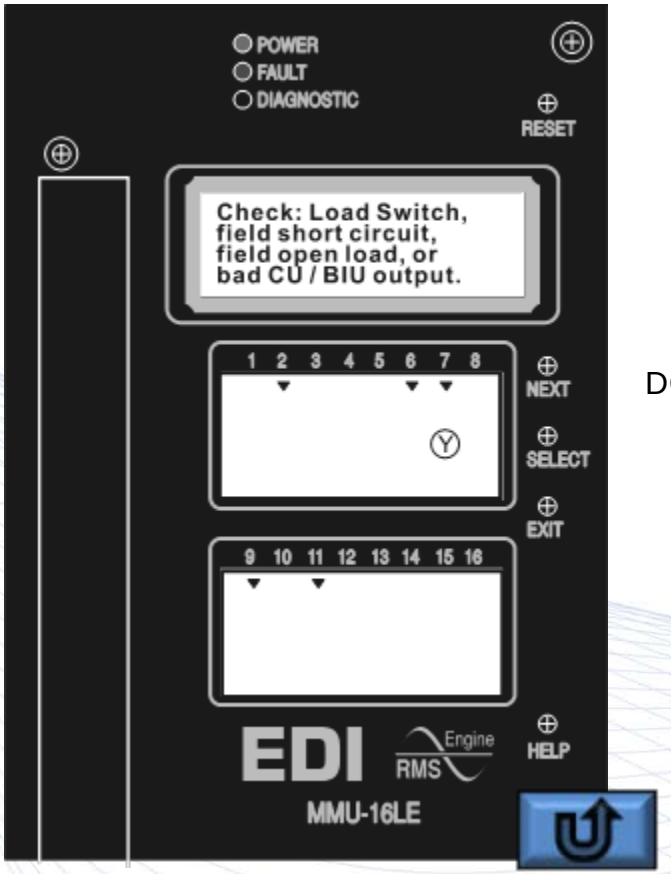
The Diagnostic Wizard

Second Wizard Screen
(Pinpoint faulty signals)



NEXT

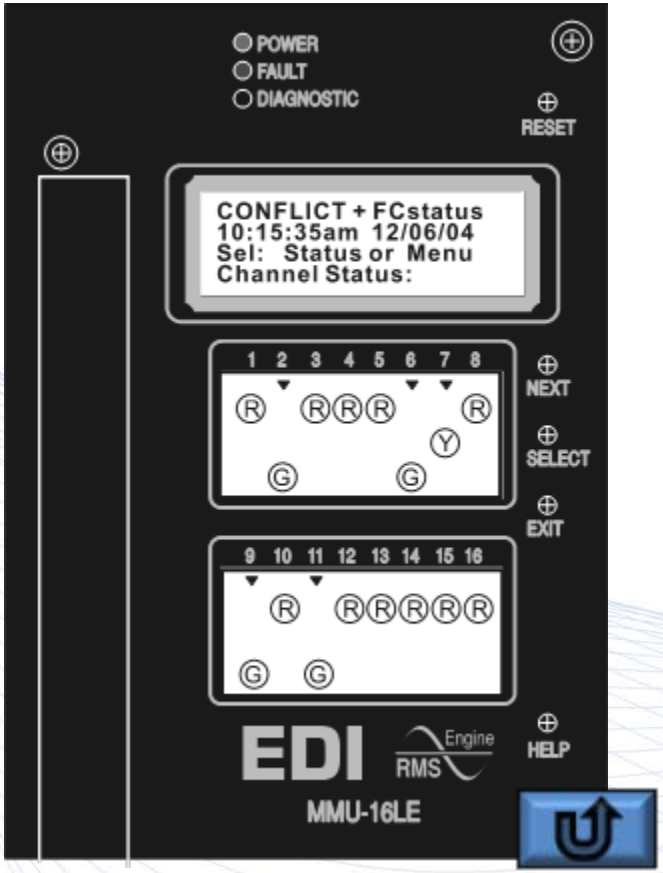
Third Wizard Screen
(Trouble shooting advice)



DONE
!

Field Check Status Mode

- Conflict Fault with Field Check Status.
  - Ch 2 & 6 are set active by the CU. Ch 7 Y is sensed active due to an open field wire.
- Field Check is the basis for the Diagnostic Wizard



Field Check Fault Mode

- The field inputs did not correspond to the CU Output commands for 1000 ms, no other fault is present.
- The field status did not result in a normal Conflict, Red Fail, Clearance Fail, or Dual Indication fault.
- The Field Check fault will be shown
- This fault is typically due to a cabinet wiring error or programming error.

SmartMonitor Programming

A technician can use the Set-up Wizard to completely program the “enhanced” monitor functions by answering a series of *intersection* questions.

- ✓ Unused, Peds, 2-section turn (PP), Vehicle…
- ✓ Field Check, Dual Indication, Red Fail, MYRCD are programmed

- The standard Nema Program Card is still used for Conflict, Min Flash, and MYCD programming.
- Enhanced function programming is also stored in nonvolatile memory on the EDI Program Card. Replacing the card transfers the total MMU2-16LE configuration database.
- Configuration databases can be up or down loaded to disk files using ECcom.

MMU2-16LE Programming Card

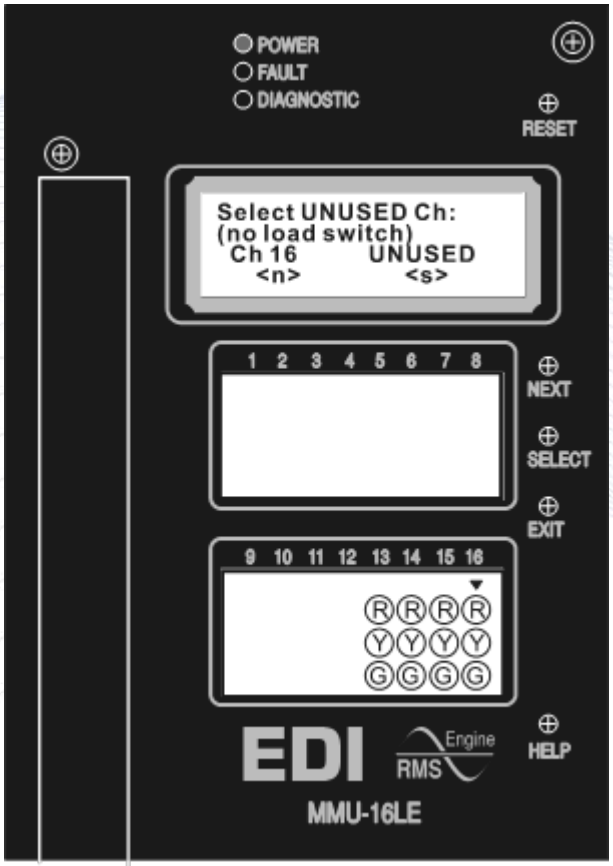
- Permissive Channel Jumpers
- Minimum Flash Time
- Minimum Yellow Change Disable (MYCD) Jumpers
- Voltage Monitor Latching Options
- Program Card Memory

SmartMonitor Enhanced Functions

- Field Check Enable
  - Enable each color input if the signal reflects the Controller load switch command.
- Dual Indication Enable
  - R-G, R-Y, & G-Y for each channel
- Red Fail Enable
- Minimum Yellow + Red Clearance
  - Disabled only for special conditions
- Unit options

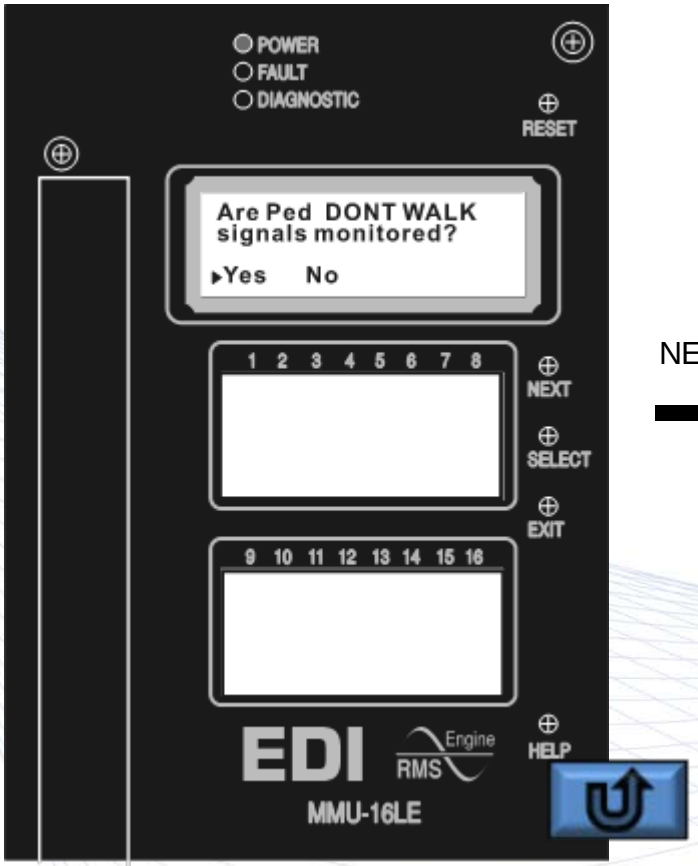
SmartMonitor Setup Wizard

First Wizard Screen
(Select Unused Channels)



NEXT

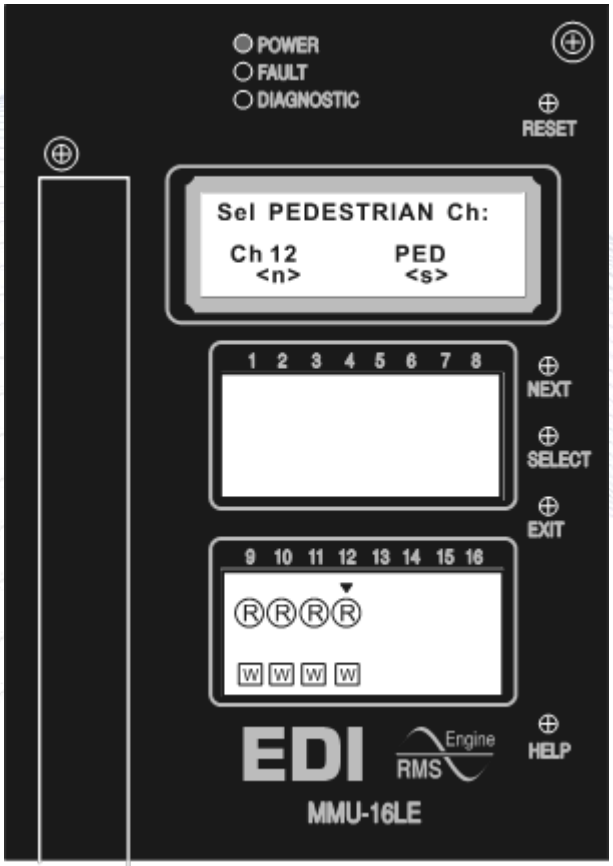
Second Wizard Screen
(Select Don't Walk Monitoring)



NEXT

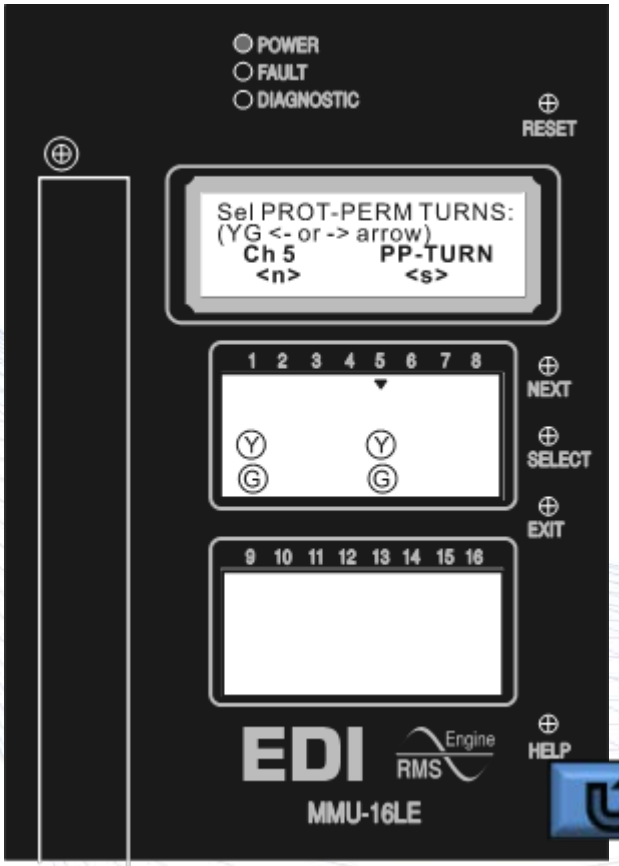
SmartMonitor Setup Wizard

Third Wizard Screen
(Select Pedestrian Channels)



NEXT

Fourth Wizard Screen
(Select Prot-Perm Channels)

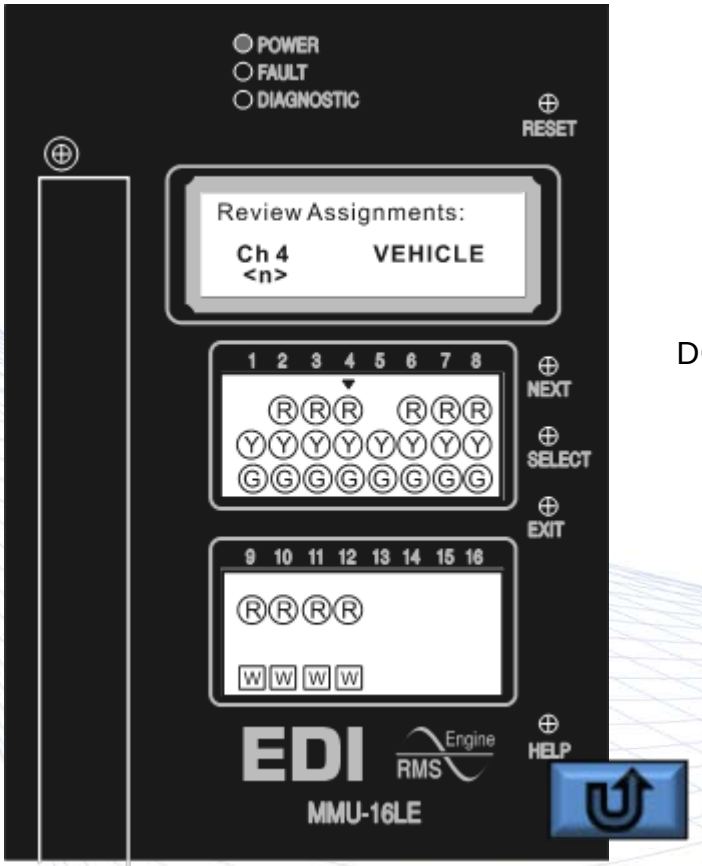


NEXT

SmartMonitor Setup Wizard

- The final step of the Set-up Wizard is to review the selected channel assignments.
- The results will be used to *automatically* program:
  - Field Check Enable
  - Red Fail Enable
  - Dual Indication Enable
  - MYRC Disable

Final Wizard Screen
(Review Channel Assignments)



DONE
!

SmartMonitor Unit Options

- Recurrent Pulse (ON)
  - Enables detection of flickering or intermittent field signals. Should be disabled for diagnostics only.
- Walk Disable (ON for Type 12)
  - TS1 mode only, eliminates Walk input from Red Fail and Dual Indication algorithms
- Log CVM Faults (ON)
  - Disable CVM logging if used for TOD Flash
- VM 3x/Day Latch (OFF)
  - Latch a CVM or 24V fault on 3rd event in 24 hours
- Extern Watchdog (OFF)
  - Monitors toggling watchdog signal from an external device

SmartMonitor Unit Options

- 24V-2 = 12VDC (OFF)
  - Enable if monitoring of the 12VDC detector supply is required and wired to 24V Monitor II input of the monitor
- PGM Card Memory (ON)
  - Enables shadow memory on the EDI Program Card
- LEDguard (ON)
  - Adjusts field thresholds to better suit LED signal operation
- Force Type 16 (OFF)
  - TS1 mode only, eliminates need for Type Select input
- Type 12 with SDLC (OFF)
  - TS1 mode only, enables SDLC communication with a TS2 Controller Unit
- Flashing Yellow Arrow

Program Card Memory

- “Shadow Memory” on the Program Card makes transferring configuration data from one unit to another easy.
- The Program Card memory also facilitates ATSI testing.
- The Program Card Memory Option must be enabled for this feature.

EDI *ECcom* Software

- Displays RMS field status, cabinet voltages and temperature, time clock, ID
- Retrieves, displays, stores event logs:
  - Previous Fail events
  - Fault Reset events
  - AC Line events
  - Configuration Change events
  - Chronological event sort
- Signal Sequence history of signals 30 seconds prior to the fault “trigger”.
- EIA-232 or Ethernet

SmartMonitor “Type 12 with SDLC” mode

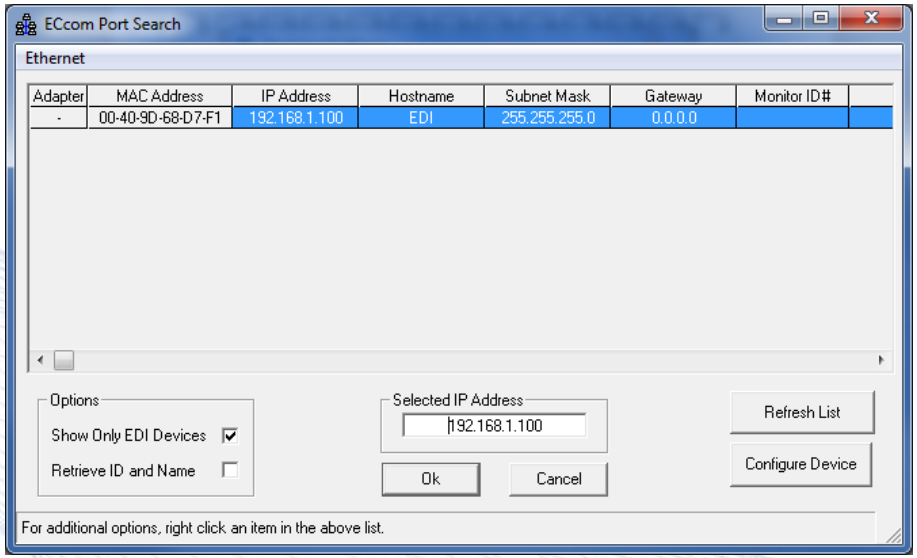
- Benefits
  - Display interface remains 12 channel TS1 mode (RYGW)
  - EDI Field Check powers the Diagnostic Wizard
    - Identifies if the CU is at fault
    - Directly pinpoints faulty signals in load bay or field
  - MMU time clock is synchronized with the CU
  - Program Card is verified against the CU ring structure
  - Start-up Call function automatically puts CU in programmed start-up phases on exit from flash
  - CU provides redundant Conflict monitoring function
  - MMU fault status is available in the CU
- Requirements
  - CU to MMU Port 1 cable
  - Peds assigned to phases 2, 4, 6, and 8
  - No wiring changes to the cabinet are needed.

Ethernet Configuration

- The default network settings from the factory are:
  - IP Address 192.168.1.100
  - Subnet Mask 255.255.255.0
- To change the *SmartMonitor* network settings
  - ECcom Search Function
    - Using ECcom DOES NOT require that the network settings of the PC match the network settings of the *SmartMonitor* (UDP)

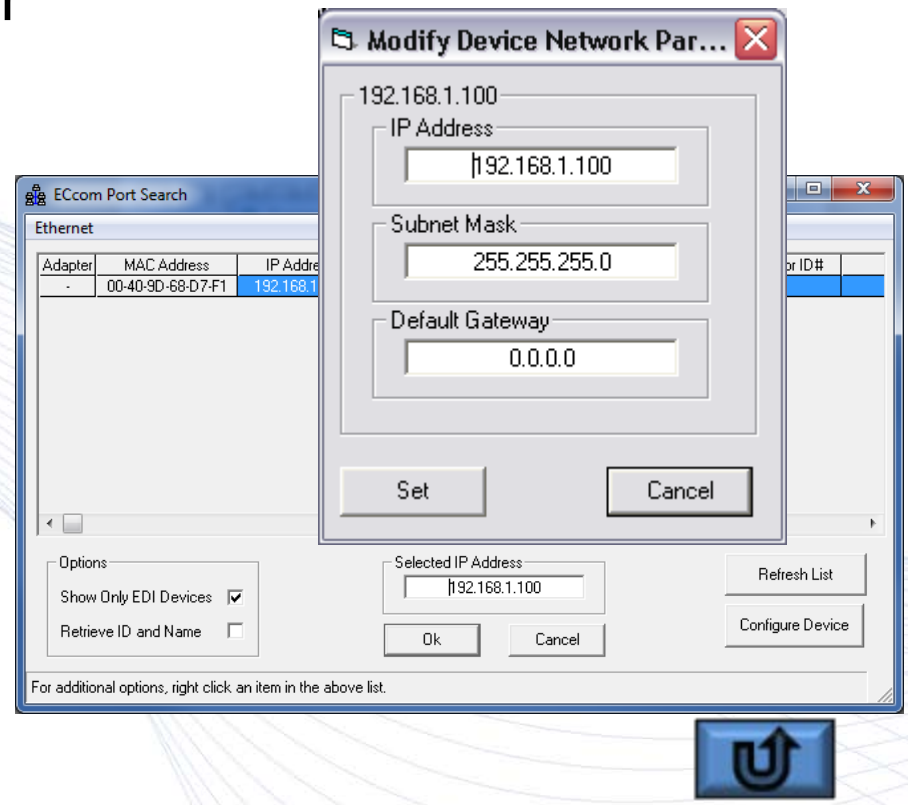
ECcom Ethernet Configuration

- SETUP / COMM PORT / SETTINGS menu item,
- Click on the SEARCH button.
- The Search function will find all EDI monitors on the local subnet.



ECcom Ethernet Configuration

- Right Click on the monitor entry that needs to be configured
- Select CONFIGURE SETTINGS
- Set the new network parameters



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MMU2-16LE *SmartMonitor*®

Setting the Standard

for

Quality and Reliability

Eberle Design Inc.

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MMU2-16LE FYA Overview

NEMA Flashing Yellow Arrow Standard

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Flashing Yellow Arrow

- Need for FYA
  - FHWA issued Interim Approval for use in March of 2006, dropping the experimental status
  - Allows protected-permitted left-turns and lead-lag phasing without the “Yellow Trap”.
  - Extremely flexible allowing protected-only or permitted-only by Time of Day or Queue
  - Has Good Driver Understanding
  - The array of phasing and detection combinations allows the engineer to maximize capacity at an intersection

Flashing Yellow Arrow Milestones

- NCHRP 3-54 Report 2003
- First FYA capable monitor deployed in 2005 by EDI
- MUTCD formal release in 2009
  - Defines Signal operation
- NEMA TS-2 FYA Amendment #4 November 2012
  - Defines Equipment operation

NEMA TS-2 FYA Amendment

- Defines both CU and MMU2 operation
  - Devices conformant to the NEMA Standard will be interoperable and interchangeable.
  - An MMU conformant to the NEMA FYA Standard is labeled an "MMU2".
- Development Cycle
  - Project started in Q1-2009
  - Completed in August 2011
  - Publication in November 2012 as:

    NEMA TS-2 Amendment #4-2012
- Compliant to MUTCD 2009

NEMA Controller Section

- NEMA Definitions
  - Four output groups with four output states
  - Uses an Overlap concept to control the permissive phases
- FYA Signal Output Group
  - Red Arrow assigned to Overlap Red
  - Solid Yellow Arrow assigned to Overlap Yellow
  - Flashing Yellow Arrow assigned to Overlap Green
  - Green Arrow assigned to LT Protected movement
- NTCIP object definitions are still needed

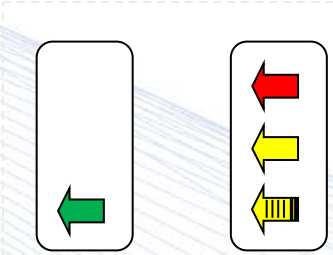
NEMA MMU2 Section

- Definitions – “MMU2”
  - Permissive Turn Channel
  - Protected Turn Channel
  - Opposing Through Channel
  - Paired Channels
- The NEMA Standard does not define a method of programming the MMU2.
  - Interchangeability is achieved when MMU2 units are configured to produce the same functional operation.

NEMA MMU2 Paired Channels

- The MMU2 uses two paired channels to monitor the four outputs of the FYA Signal Output Group.

Load Switch #A
Protected Channel

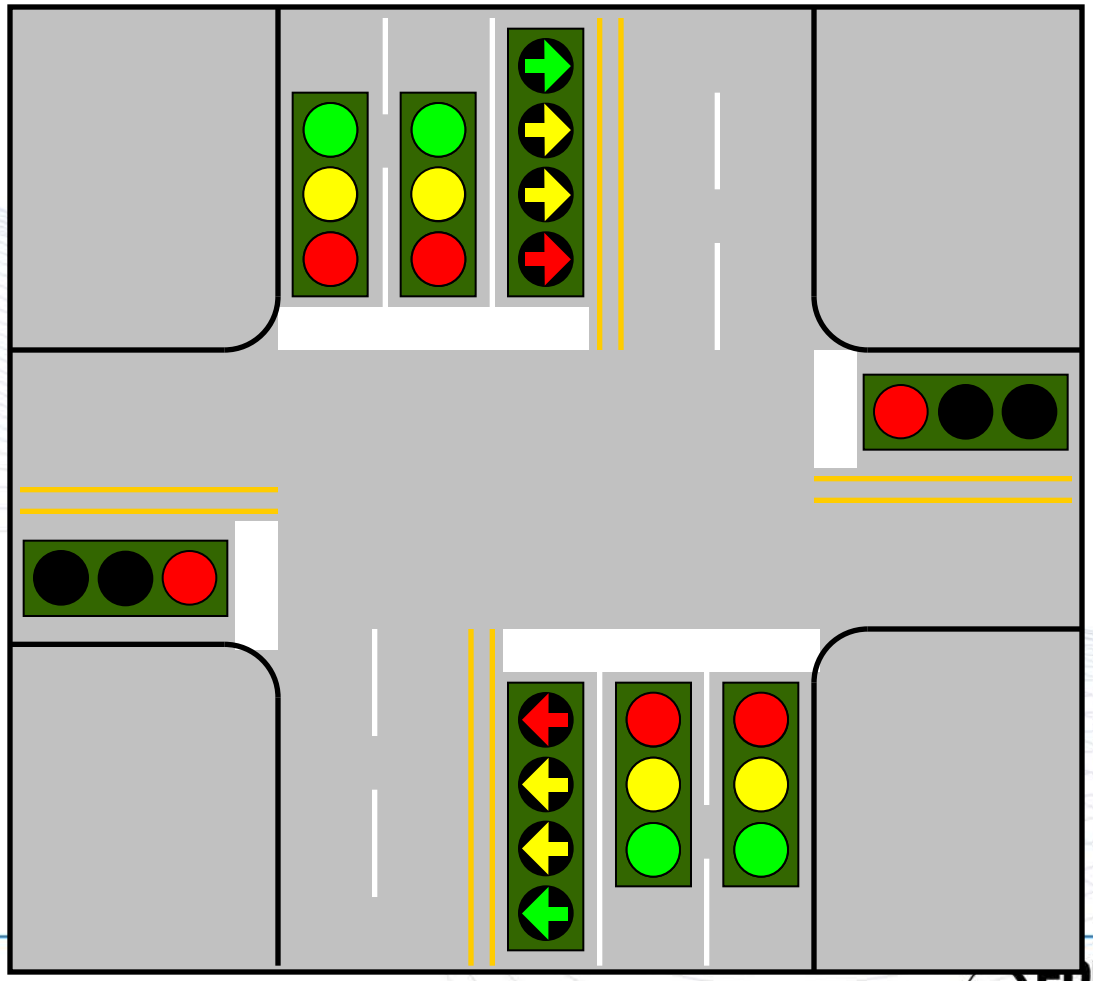


Load Switch #B
Permissive Channel

- Each FYA approach typically requires two load switches and two MMU channels.
- Unused Red and Yellow outputs of the Protected channel can be disabled.

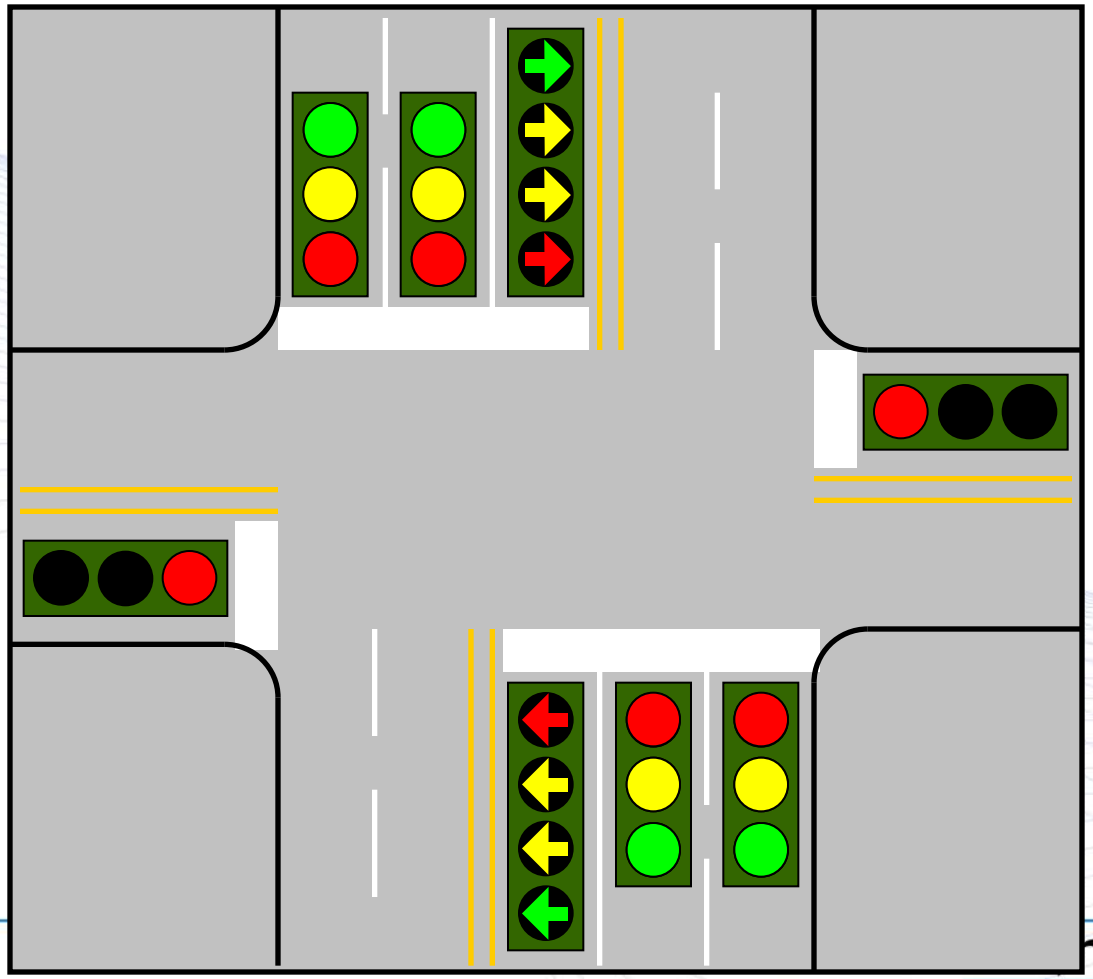
How a Flashing Yellow Arrow Left Turn Works

- Protected Only



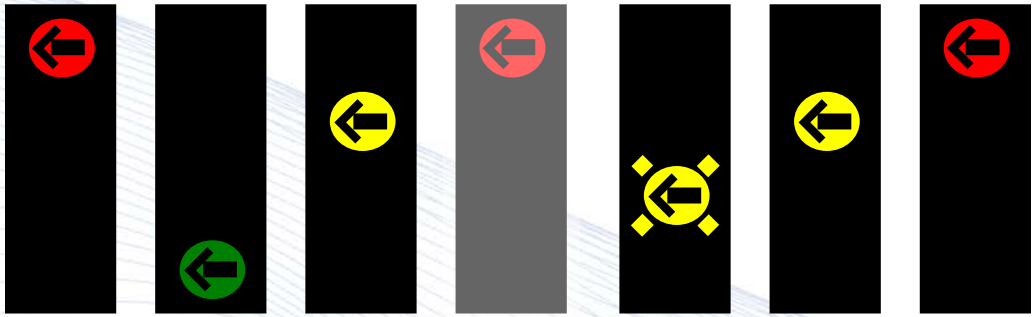
How a Flashing Yellow Arrow Left Turn Works

- Permissive Only



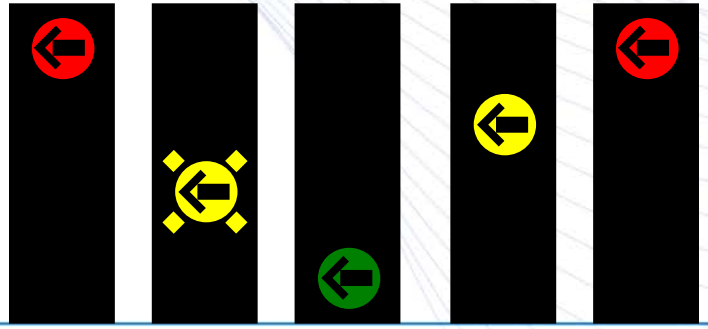
How a Flashing Yellow Arrow Left Turn Works

Leading Protected / Permissive



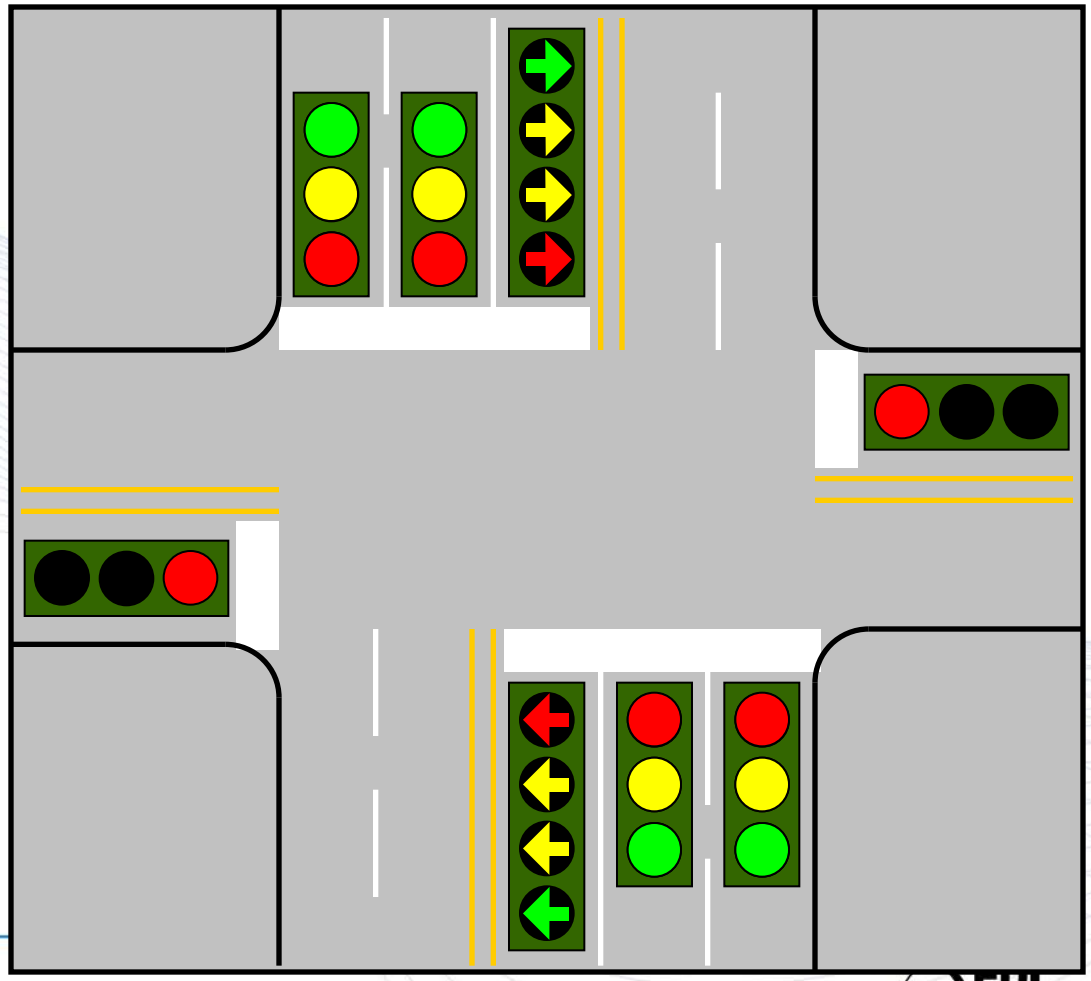
Optional

Lagging Protected / Permissive



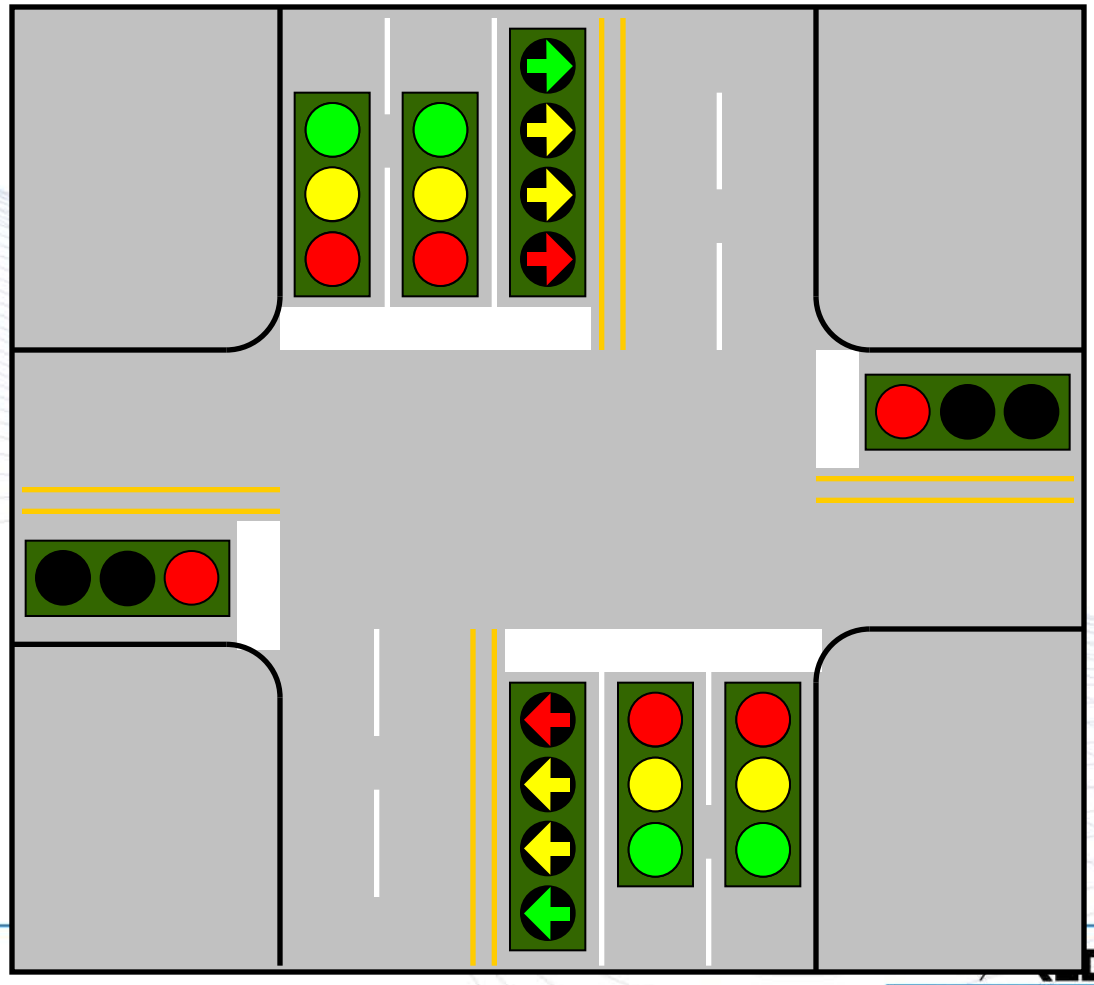
How a Flashing Yellow Arrow Left Turn Works

- Leading Protected / Permissive



How a Flashing Yellow Arrow Left Turn Works

- Lagging Protected / Permissive



MMU2 Paired Channel Modes

- The NEMA Standard provides for a minimum of 8 modes.
  - Four modes require no remapping
    - Two load switches and two MMU channels per approach
  - Two modes remap the Ped Yellow outputs
    - One+ load switch and two MMU channels per approach
  - Two *alternate* modes
    - One+ load switch and one+ MMU channel per approach
- Preconfigured modes simplify the cabinet and MMU2 setup and follow typical phase to channel assignment conventions in use.
- Choose a mode based on cabinet resources and level of remapping to be tolerated.

How to Choose a Mode

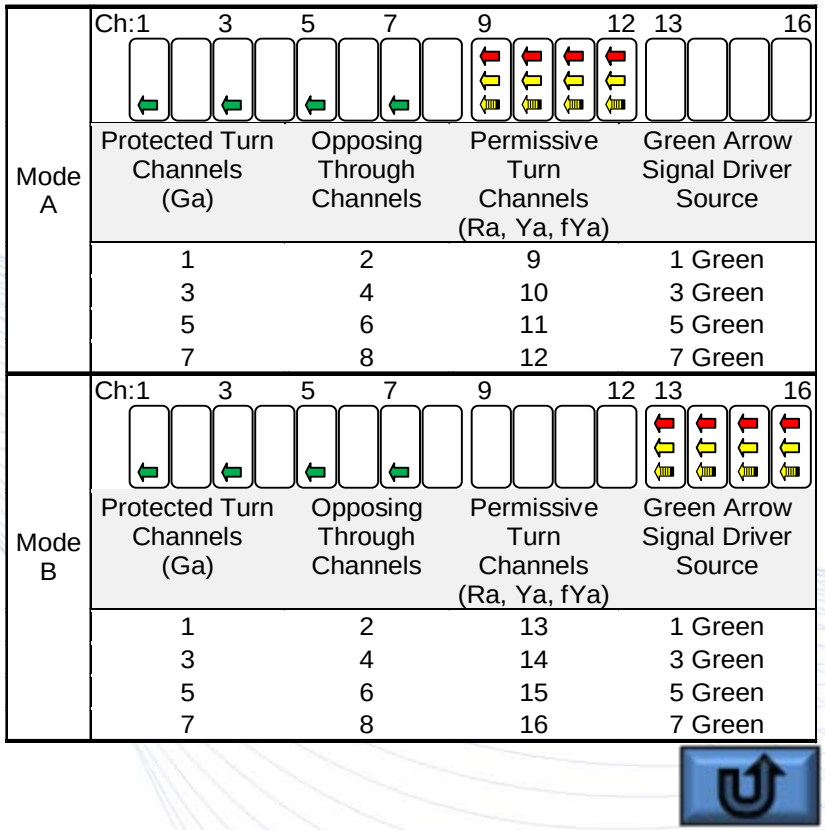
Assume each FYA approach needs 2x MMU channels and 2x load switches.

- If the cabinet can provide two MMU channels and two load switches for each FYA approach then use Modes A-D.
  - Simple configuration with No mapping.
- If the cabinet can provide two MMU channels but does not have an additional load switch for each FYA approach then use Modes E-F.
  - For example, a 12 position back panel.
  - CU mapping and MMU mapping required, adds programming and trouble shooting complexity.
  - Monitoring of Pedestrian Yellow Clearance interval for Conflicts is sacrificed.
- If the cabinet does not have any additional MMU channels or load switches then use Modes G-H.
  - For example, 4 thru + 4 Ped + 4 OLPs + 4 FYA.
  - CU mapping required, adds programming and trouble shooting complexity.
  - Restricts FYA permissive programming to be the same as the parent Ped phase programming.
  - MMU display combines the flashing Yellow Arrow icon with the Ped Walk and Don't Walk icons.

Modes A-B (No Mapping)

- Modes A and B assign the Protected turn phases to channels 1, 3, 5, and 7, and the Permissive turn overlap phases to either channels 9-12 or 13-16.

- This accommodates cabinets that have pedestrian phases assigned to either channel group;
  9-12 or 13-16



	Protected Turn Channels (Ga)	Opposing Through Channels	Permissive Turn Channels (Ra, Ya, fYa)	Green Arrow Signal Driver Source
Mode A	1	2	9	1 Green
	3	4	10	3 Green
	5	6	11	5 Green
	7	8	12	7 Green
Mode B	1	2	13	1 Green
	3	4	14	3 Green
	5	6	15	5 Green
	7	8	16	7 Green

Modes C-D (No Mapping)

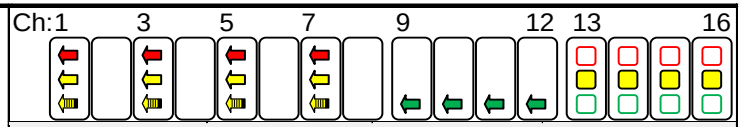
- Modes C and D assign the Protected turn phases to either channels 9-12 or 13-16. Channels 1, 3, 5, and 7, are the Permissive turn overlap phases.
- This accommodates cabinets that have pedestrian phases assigned to either channel group, 9-12 or 13-16

	Protected Turn Channels (Ga)	Opposing Through Channels	Permissive Turn Channels (Ra, Ya, fYa)	Green Arrow Signal Driver Source
Mode C	9	2	1	9 Green
	10	4	3	10 Green
	11	6	5	11 Green
	12	8	7	12 Green
Mode D	13	2	1	13 Green
	14	4	3	14 Green
	15	6	5	15 Green
	16	8	7	16 Green

Modes E-F (Ped-Y Mapping)

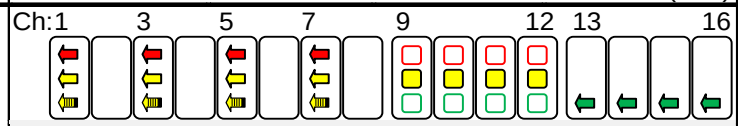
- Modes E and F have the Ped-Y outputs remapped to drive the Protected turn phases.
  - Mapping adds a level of difficulty to trouble shoot.
- Modes E and F would be used when there are not enough load switches provided in the back panel.

Mode E



Protected Turn Channels (Ga)	Opposing Through Channels	Permissive Turn Channels (Ra, Ya, fYa)	Green Arrow Signal Driver Source
9	2	1	13 Yellow (Ped)
10	4	3	14 Yellow (Ped)
11	6	5	15 Yellow (Ped)
12	8	7	16 Yellow (Ped)

Mode F



Protected Turn Channels (Ga)	Opposing Through Channels	Permissive Turn Channels (Ra, Ya, fYa)	Green Arrow Signal Driver Source
13	2	1	9 Yellow (Ped)
14	4	3	10 Yellow (Ped)
15	6	5	11 Yellow (Ped)
16	8	7	12 Yellow (Ped)

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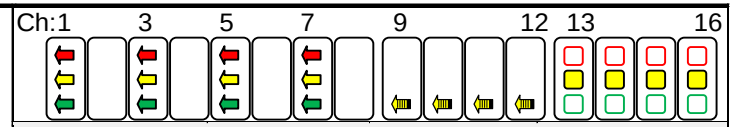
Modes I-J (Ped-Y Mapping)

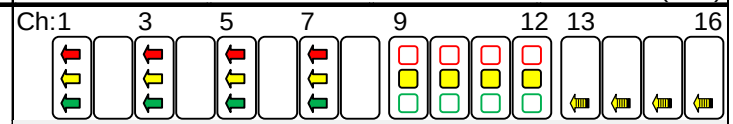
- Modes I and J have the Ped-Y outputs remapped to drive the Permissive turn phases.
  - Mapping adds a level of difficulty to trouble shoot.
- Modes I and J would be used when there are not enough load switches provided in the back panel.
- Retrofit would be easier.

Mode I



Protected Turn Channels (Ra, Ya, Ga)	Opposing Through Channels	Permissive Turn Channels (fYa)	Flashing Yellow Arrow Signal Driver Source
1	2	9	13 Yellow (Ped)
3	4	10	14 Yellow (Ped)
5	6	11	15 Yellow (Ped)
7	8	12	16 Yellow (Ped)

Mode J



Protected Turn Channels (Ra, Ya, Ga)	Opposing Through Channels	Permissive Turn Channels (fYa)	Green Arrow Signal Driver Source
1	2	13	9 Yellow (Ped)
3	4	14	10 Yellow (Ped)
5	6	15	11 Yellow (Ped)
7	8	16	12 Yellow (Ped)

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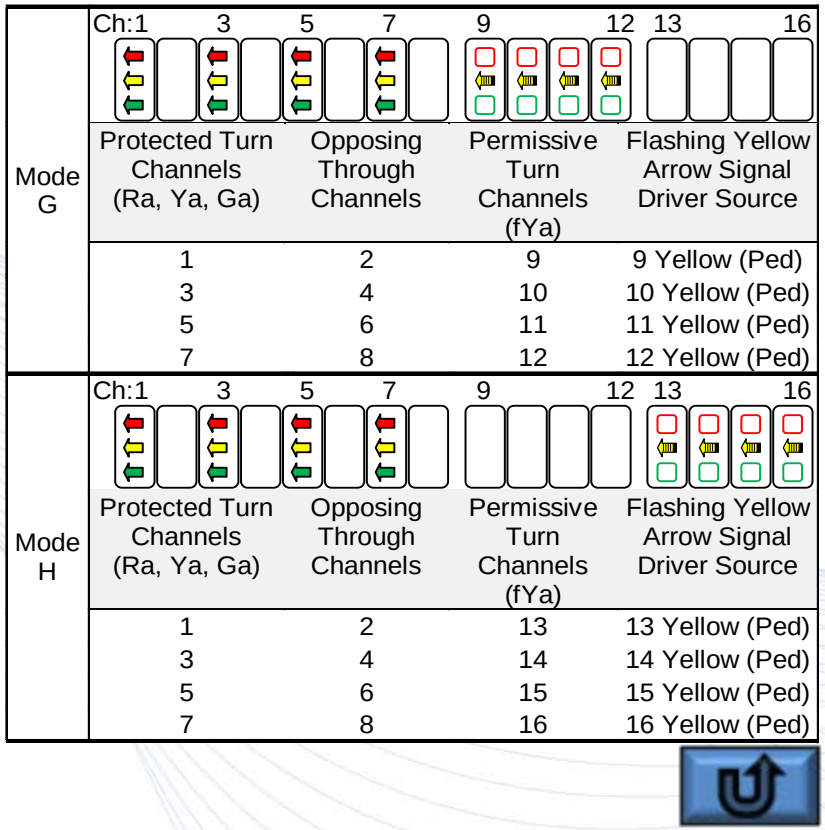
Modes G-H (Alternate, Mapping)

- Modes G and H have the Ped-Y outputs remapped to drive the Permissive turn phases.
  - Permissive turn channels assume compatibility programming and display of the associated Ped phases.
- Modes G and H are used when there are not enough load switches and/or channels provided.
  - Simplify retrofits & use only one MMU channel per pair
  - Leaves four channels available for normal overlap uses. For example, 4 thru + 4 ped + 4 OLPs + 4 FYA



	Protected Turn Channels (Ra, Ya, Ga)	Opposing Through Channels	Permissive Turn Channels (fYa)	Flashing Yellow Arrow Signal Driver Source
Mode G	1	2	9	9 Yellow (Ped)
	3	4	10	10 Yellow (Ped)
	5	6	11	11 Yellow (Ped)
	7	8	12	12 Yellow (Ped)
Mode H	1	2	13	13 Yellow (Ped)
	3	4	14	14 Yellow (Ped)
	5	6	15	15 Yellow (Ped)
	7	8	16	16 Yellow (Ped)

Modes K-L (Alternate, No Mapping)

- Modes K and L assign the Permissive turn phases to either channels 9-12 or 13-16. Channels 1, 3, 5, and 7, are the Protected turn phases.
- Retrofits would be easier, but this assignment does not follow the NEMA overlap definition.

	Ch:1 3 5 7 9 12 13 16			
Mode K	Protected Turn Channels (Ra, Ya, Ga)	Opposing Through Channels	Permissive Turn Channels (fYa)	Flashing Yellow Arrow Signal Driver Source
	1	2	9	9 Green
	3	4	10	10 Green
	5	6	11	11 Green
	7	8	12	12 Green
	Ch:1 3 5 7 9 12 13 16			
Mode L	Protected Turn Channels (Ra, Ya, Ga)	Opposing Through Channels	Permissive Turn Channels (fYa)	Green Arrow Signal Driver Source
	1	2	13	13 Green
	3	4	14	14 Green
	5	6	15	15 Green
	7	8	16	16 Green

Additional FYA Functions

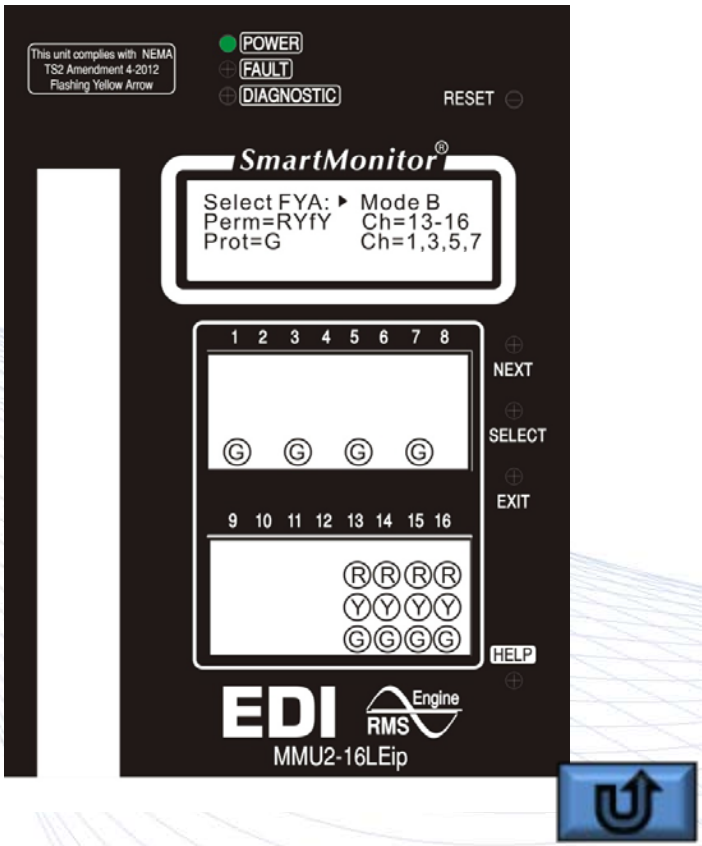
- Dynamic Clearance Conflict Detection
  - During Permissive clearance interval, the solid Y arrow is compatible with the opposing thru phase.
  - During Protected clearance interval, the solid Y arrow is conflicting with the opposing thru phase.
- Flashing Yellow output is monitored for a stuck-on malfunction.
- Protected channel R and Y inputs can be disabled if not utilized.

MMU2-16LE FYA Programming

First step is to select the Mode, A-L.

For each mode selected the display will show the channel assignments.

For Type 12 operation only modes A, C, G, and K are provided.



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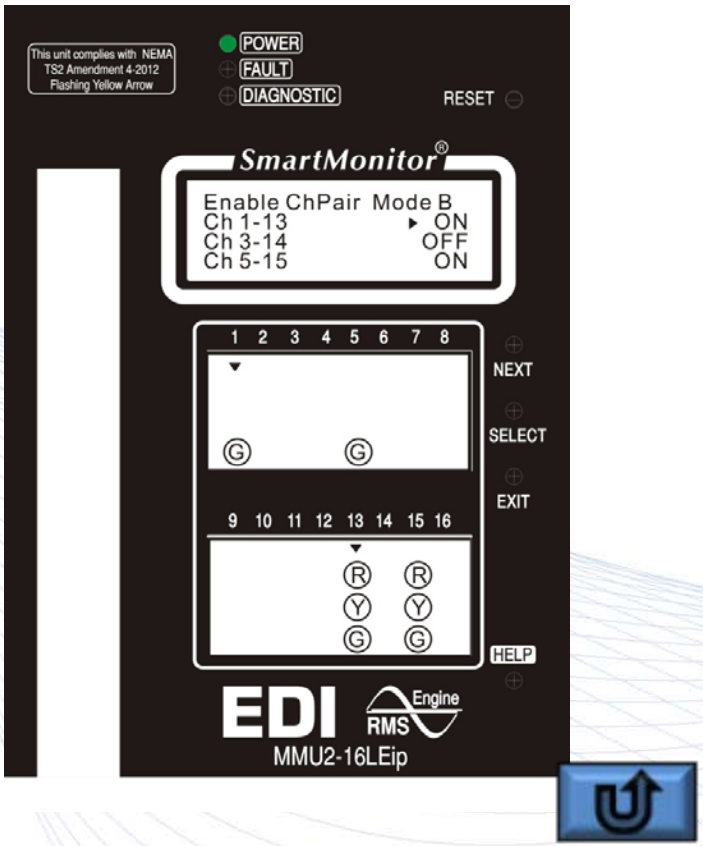
MMU2-16LE FYA Programming

Second step is to Enable a channel pair for each approach.

For each pair enabled the display will show the channel assignments.



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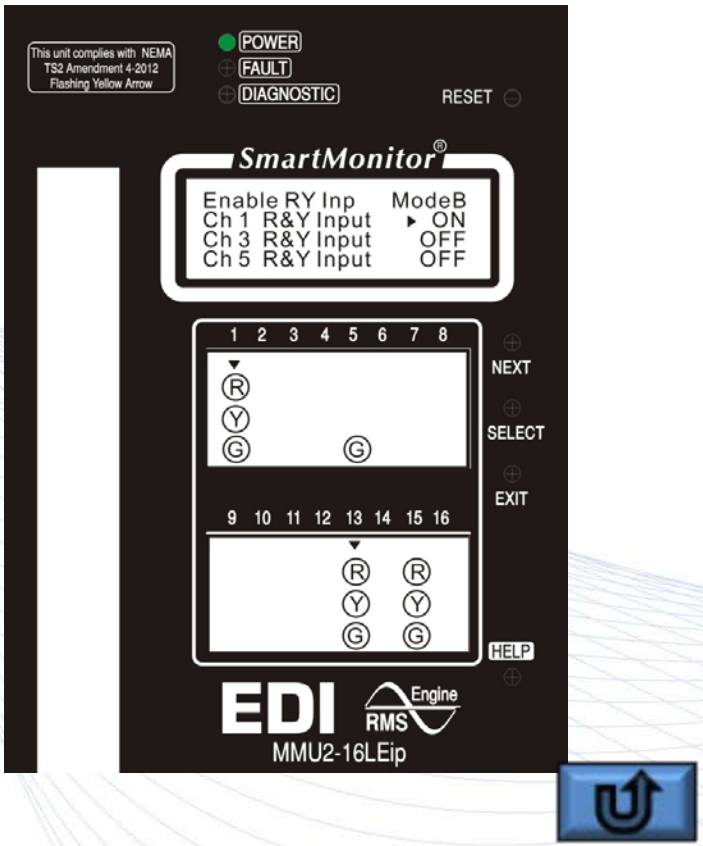
MMU2-16LE FYA Programming

Third step is to Enable the use of the Red and Yellow input of the sparse channel (G only) if needed.

Typically, the R&Y input is disabled, and the MMU will ignore any voltage on the inputs and set them to Off. This eliminates the need to use a dummy resistor on the unused Red and Yellow load switch outputs.



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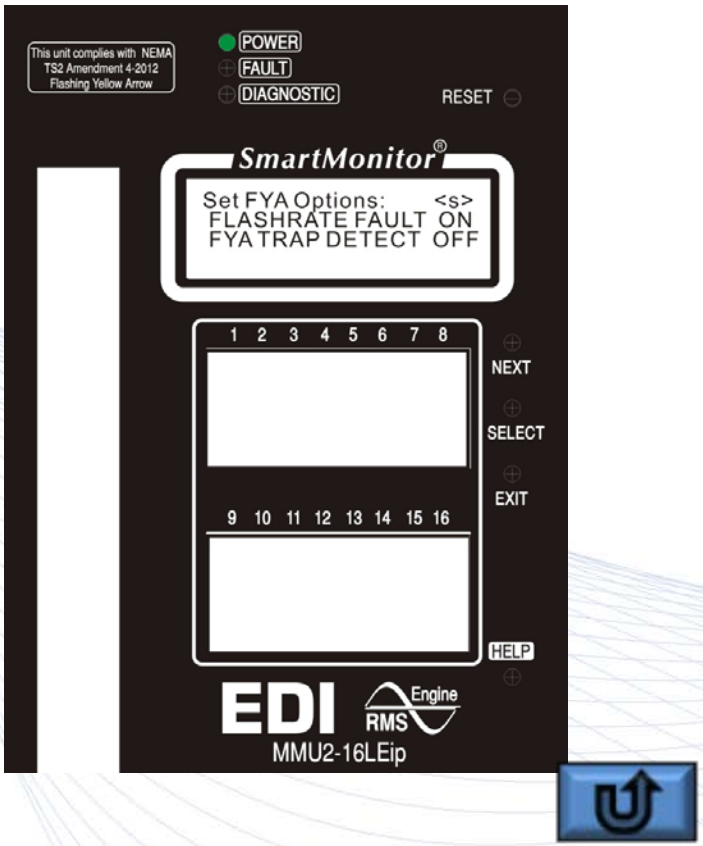
MMU2-16LE FYA Programming

Final step is to select the FYA Options.

The *FlashRate Fault* option will set a fault if the flashing Yellow Arrow stops flashing.

The *FYA Trap Detect* option will set a fault if the permissive turn channel (fYa) clears to solid Yellow while the opposing thru phase is Green.



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EDI FYA Product Plans

- NEMA published the FYA Standard in November 2012.
- NEMA FYA functionality will be released as the MMU2-16LE(ip) product.
  - The MMU2-16LE(ip) is functionally the same as the MMU-16LE(ip) but includes the NEMA FYA compliant operation.
  - The MMU-16LE(ip) product line will continue with the basic FYA and FYAc modes of operation.
- The EDI MMU2-16LE *SmartMonitor* will provide an additional four FYA modes beyond the NEMA standard for a total of 12 modes.
- EDI SSM-LE (TS-1) and 2010ECL product firmware updates will closely follow.

FAQ

- What is the difference between the MMU2-16LE and the MMU-16LE?
  - The units are functionally the same except for the FYA operation. The MMU2-16LE complies with the new NEMA standard. The MMU-16LE is provided for backward compatibility with existing FYA installations.
  - NEMA Mode B is equivalent to the MMU-16LE "FYA" mode.
  - NEMA Mode F is equivalent to the MMU-16LE "FYAC" compact mode.
- Is there any price difference?
  - No.
- Can EDI update the MMU-16LE firmware to the MMU2-16LE?
  - Yes
- Can a user reflash the MMU-16LE with MMU2-16LE firmware?
  - Yes, consult the factory for details and firmware files.
- If an MMU-16LE is returned for factory repair and needs a firmware update, will it be automatically updated to MMU2-16LE level?
  - No, it will only be changed to MMU2-16LE firmware if requested.

Conclusion

- Be aware of new technology advancements.
- Keep equipment specifications up to date.
  - You are likely not using the same cell phone or TV that you used even 5 years ago.
- Technicians must learn to be more productive and more effective to keep up.
- New applications such as Flashing Yellow Arrow provide opportunities to move more vehicles and in a safer manner.

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